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PROTECTING SATELLITES WITHOUT WEAPONS – IS IT LOGICAL?

By

David Matawitz
CDR, USN

A paper submitted to the faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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Satellites are a critical vulnerability requiring protection against attack. The question facing U.S. planners is how this can be done. Two broad options are available to protect satellites: offensive and defensive means.

On the surface, offensive weapons seem to offer the capability of deterring adversaries by threat of retaliation. Proponents claim the weapons will allow commanders to prepare the battle space for war by denying the enemy satellite connectivity. Furthermore, it seems like the United States would only be keeping pace with numerous rogue states that are already developing offensive Anti-Satellite (ASAT) weapons.

However, offensive weapons are not the answer. They will not deter aggression, provide information dominance in the battle space, or protect satellite assets. Offensive weapons will only serve to encourage others to accelerate ASAT research, alienate allies, encourage the weaponization of space, and waste limited funding.

The correct solution is defensive measures. Granted these are riskier, more costly, and in direct contradiction to military training, but these measures offer an ability to realistically protect assets without alienating allies or weaponizing space. Treaties, system redundancy, quick launch platforms, leased assets, and physical defenses will protect assets at a much reduce political and moral cost.

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Introduction/Thesis

Protecting U.S. satellites from attack is vital to maintaining space supremacy, information dominance, and winning future wars. This is fact, beyond conjecture. However, what is not clear is how this is to be done. America needs to determine the best method of protecting these assets before an adversary attacks this critical vulnerability.

Future adversaries observed the United States during the Persian Gulf War. They saw not only the power of precision-guided munitions, but also the dominance space-based information provided. America proved that space superiority would make the difference between victory and defeat in future wars. Space is the undisputed ultimate high ground.[1]

Many options have been proposed for protecting U.S. satellites. Both offensive and defensive measures have been suggested, from Anti-Satellite (ASAT) weapons to defensive stealth technology. Choosing the best method is vital not only to national security, but in determining how the United States will influence the development of space. This paper will explore the advantages and disadvantages to a variety of measures. It will determine which methods offered the best potential to U.S. operational planners in protecting our satellite constellation and ensuring information dominance is maintained.

Offensive measures

The military's knee-jerk response to satellite protection is to build a weapon. On its face, this simplistic view seems reasonable. If we had a weapon capable of destroying an adversary's satellite, maybe they would be deterred from attacking ours. An offensive space weapon would also prepare the battle space by denying our enemy satellite

connectivity. Finally, the United States would only be keeping pace with numerous rogue states that are already developing ASAT weapons, not to develop one would be naive.

The technology exists today to develop a very effective ASAT weapon. The MIRACL has already been proven successful and the Kinetic Energy (KE) ASAT has been funded through FY00. The question the United States still needs to address is whether we should be led by technology onto an offensive path or whether we should drive technology towards defensive means of protecting our space assets. Should we adopt an offensive satellite weapon because we can or because others do? Examining each perceived advantage of offensive weapons will help to determine their true usefulness.

The first advantage is that offensive weapons will deter rogue states from attacking our satellites. General Charles Horner, Desert Storm air commander, said the United States needs an ASAT capability because "that makes your diplomacy have teeth." Deterrence involves informing adversaries, in advance, that if actions are begun against friendly space systems, then corresponding retaliatory steps will be taken. The United States cannot deter a rogue nation from attacking U.S. satellites without the capability to enforce that threat. An offensive weapon provides the United States the "teeth" needed to deter aggression.[2]

There are several counter arguments to the benefits offensive satellite weapons will provide to deterrence. First, deterrence presumes that the United States has the political fortitude to use the weapon against an enemy's satellite. Additionally, the United States must have the ability to confirm - one hundred percent, that the satellite

failure was caused by a specific nation, was not due to nature failure, that if we attacked we would by retaliating against the adversarial nation only, and that this politically risky attack would succeed in the enemy's isolation. Finally, for deterrence to succeed, an enemy must believe that his potential losses will exceed possible gains.[3]

The first requirement, political fortitude is important. It is doubtful the United States would act unilaterally with a weapon of such political importance. Satellite attacks would open the door to a new form of warfare and destruction. Furthermore, the United States is not alone in its dependence on a satellite infrastructure. Would our allies agree to America beginning a satellite war of attrition? The United States could receive severe moral condemnation from the world community if it were to take drastic military action in response to the destruction of a satellite. Even if America was willing to risk such general condemnation, the delicate nature of a coalition was demonstrated during the Gulf War, which showed that there are practical reasons for refraining from military escalation.[4] Developing the political fortitude to act, with potentially no allied support, would be very difficult for the United States.

There is still a larger political issue than just the fortitude to use the weapon. If the United States did develop ASAT weaponry, how would we be perceived on the world stage? Any effort by the United states to weaponize space will not only incite potential adversaries to follow suit, but will also be perceived as provocative by allies. The world is watching the United States as it develops space and is confused as to U.S. intentions. The world community is shocked that America is proposing the development of space weaponry now, during a time of START II and Nuclear Test Ban treaties.[5] These

concerns have not only arisen from rogue states desiring to demonize the United States, but from some of our closest allies.

History is full of examples of one nation becoming dominant over all others due to its military or economic power. These powerful nations are usually resented, feared, or identified as dangers to other less developed nations. This fear of what a powerful country might do has been the cause of past wars. Athens is a good example. Its dominance caused others to perceive the need to attack it, before Athens attacks them. The next war may be a preemptive war of self-defense against the United States - a war caused by the United States being perceived as a threat to world stability.[6]

In the interest of deterrence, the projection of overwhelming strength may be desired. However, on the world stage when the United States is trying to forge alliances and build trust, this military dominance may actually drive potential allies away. The United States will claim that ASAT weapons were only designed to protect both U.S. and worldwide satellite assets. Whether this is true or not, other nations will perceive ASAT technology as a U.S. attempt at world domination. Weaker nations have a natural tendency to unite and oppose emerging hegemonies.[7]

The second limitation of an offensive approach is the inability to confirm both an attack and the identity of the attacker. U.S. satellites do not currently have the ability to identify the cause of a failure. Would the United States be willing to retaliate against another country's satellite based on an assumption of guilt? Satellites can fail due to natural causes unrelated to enemy action. Even if an attack is proven, how can the source of aggression be determined? It is unlikely any country would take credit for the assault.

The United States would have to retaliate based on an assumption. This could prove to be a very danger act that might hurt American creditability in the eyes of other nations.

Finally, deterrence may be difficult to carry out effectively against a Third World country. Threatening to destroy an attacker's satellites in retaliation for loss of one of yours is infeasible if the attacker does not operate satellite systems. Deterrence will only work if your enemy fears the threat.[8]

If an enemy destroyed a U.S. satellite and we responded in kind with offensive weapons, who would stand to lose more? U.S. reliance on satellites to maintain command, control, communications, and intelligence is extensive. America's current dependence on satellites makes it a critical vulnerability. With the limited number of overcrowded channels, the United States cannot afford a single loss. A satellite war, therefore, would place the United States ultimately at a disadvantage.[9]

Furthermore, deterrence will only work if your enemy fears the potential loss he may suffer. An adversary would take the military advantage by denying both themselves and the United States satellite access.[10] What would constrain a crumbling North Korea from firing a nuclear weapon into Low Earth Orbit (LEO) during a war with the U.S.?[11] An ASAT would not deter aggression. Deterrence only succeeds if your enemy has more to lose than yourself.

A second promulgated advantage is that offensive weapons will prepare the battle space for war. An offensive weapon would allow the military to seize control of the space medium prior to war. Enhancing friendly satellite connectivity, while degrading the enemy's is the foundation of battle space preparations. General John L. Piotrowski-a previous Commander in Chief of U.S. Space Command advised, "The side that loses the

space battle will very likely be unable to meet its objectives on land, at sea, or in the atmosphere."[12]

Proponents claim that the United States should be able to develop offensive weapons to deny mission survivability to enemy space systems. During prewar preparations, the enemy should be led to expect the unannounced demise of his platforms in orbit.[13]

However, the United States must weight the advantages and disadvantages of this action. A U.S. attack on an enemy's satellite constellation might be beneficial in degrading his intelligence network, but would it blind him? It might degrade his effort, but would probably not curtail his ability to access the data via other means.

During the next several years, upwards of one hundred commercial and civil imaging systems will be launched to provide subscribers with electro-optical, radar, multi-color, multi-spectral imagery with 1-meter resolution or better. No longer, the sole purview of the military and intelligence communities with accompanying classification restrictions, earth surveillance has become big business for numerous international corporations. This worldwide coverage by a host of conglomerates will require a fundamental change in the way America perceives satellite security and information dominance.[14]

Satellite acquired information will spill into the marketplace so fast that military policy makers will not be able to keep up. The ability of satellites to gather and transmit information will grow exponentially.[15] Civilian companies will look to gather what their customers' desire. In addition to the exportation of image maps, the transfer of target databases to other states and military groups that lack such valuable information is

expected. Because digital imagery is such a fluid commodity, the data is relatively easy to transfer via telephone lines, radio transmissions, or storage media in diplomatic pouches. One transaction could include the entire target list for a state.[16]

There is no question that this free flow of information between potential adversaries and allies will cause military planners problems in the future. The Chinese already have access to commercial satellite imagery from the French SPOT satellites, Indian IRS-1c satellite, Canadian RADARSAT, and various Russian satellites. It is impossible to isolate specific nations from satellite information. With the numerous corporations and countries supplying data, there is no tracking mechanism. Furthermore, there is no method of preventing data from being transferred second, third, or fourth hand. The United States will need to accept the probability that all nations will have access to satellite information. Short of shooting down every non-U.S. satellite, there is no stopping it.[17]

One solution may be that America would ask satellite intelligence suppliers to deny access to rogue nations before a conflict. During the Gulf War, France and Russia refrained from providing Iraq with satellite imagery, and it is hoped that in the future other countries, such as Israel or India, will demonstrate similar prudence. However, if they do not, they are not likely to announce this transgression to the world. The wholesale American destruction of French, Russian, Chinese, Indian, and Israeli imaging satellites, on the off chance that one of these countries might be passing an adversary information, does not seem plausible.[18]

Assuming we were not attacking a vast number of national satellites, but only one specific country's asset, could we identify it with one hundred percent certainty? During

battle space preparations, distinguishing space friend from space foe would prove difficult since most nations do not "flag" their satellites. Additionally, a number of satellites are owned by multinational corporations or shared by several nations as part of a combined space effort. Would we be willing to alienate other nations to destroy a rogue nation's satellite? Coalitions have become very important; conducting any operation that could jeopardize them would be counterproductive.[19]

Shaping the battle space prior to a conflict with offensive satellite weapons will not ensure U.S. information dominance or isolate a rogue nation. Satellite information is so widely available that a nation could receive the same data via another source.

A final argument for offensive weapons is that other nations are already developing them. The United States would only be keeping pace with others. For years, the Soviet Union had developed and deployed ASAT weapons. More recently, the Pentagon reported, "The China's Peoples Liberation Army is building lasers to destroy satellites and already has beam weapons capable of damaging sensors on space-based reconnaissance and intelligence systems." China will soon have the ability to blind U.S. military space systems vital for protecting and deploying U.S. forces.[20] A simple, direct-ascent ASAT based on a ballistic missile is now well within the grasp of many nations. If paired with an accurate guidance system such a weapon would pose a significant threat to LEO satellites.[21]

An even cheaper alternative to a laser or missile requiring complex guidance and control systems is a nuclear bomb. In space, a nuclear weapon does not create a blast or heat effects as it does when detonated within the atmosphere. It produces X-rays from an Electro-Magnetic Pulse (EMP) capable of instantly and permanently blinding satellites.

In addition, if exploded at the right altitude, even a single nuclear bomb could intensify the inner Van Allen belt. This would slowly cause the degradation and eventual failure of unhardened satellites around the Earth. Satellites can be hardened against nuclear effects, but the cost and weight trade-offs are too restrictive.[22]

An attack of this sort offers many advantages to an aggressor. It is low tech. There is no requirement to track the target or deliver the warhead near the vicinity of the satellite. It is also relatively humane. Granted a nuclear weapon is detonated, but no lives are lost and no cities are destroyed. Finally, a country could detonate it over its own territory; claim that it was only conducting a test, and that it did not intend to damage any satellites. If U.S. satellites were damaged it would be advertised as simply an accident. The advantage this would provide an adversary would be largely one-sided. Granted, his satellites would be damaged too, but the United States depends far more on LEO satellites than either North Korea or Iraq, for example.[23]

Developing an offensive satellite weapon to keep pace with other nations will give the United States an ASAT capability, but little else. An ASAT weapon will not safeguard U.S. satellites from a nuclear attack or guarantee information connectivity. How will it protect satellites? A simple nuclear blast in an adversary's owns atmosphere can blind the world's satellites. This would allow the aggressor free reign to move troops, attack neighbors, or launch missiles without interference from either the United States or any other country.

Theoretically, an offensive ASAT weapon seems like a perfect counter to aggression. However, realistically, its use is questionable. The political, technical, and moral restraints will prevent military options that involve actually destroying satellites.[24]

Before pouring limited funds into an unusable weapon, and thus a non-deterrent, other options to ensure satellite information dominance need to be explored.[25]

Defensive measures

Although defensive measures are more risky, they offer more advantages than offensive weapons. Defensive measures will develop international cooperation and partnerships in space, protect both military and civilian systems, forge closer security ties, strengthen alliances, and improve interoperability.[26]

Initially, military planners will immediately reject defensive measures. They are "anti-operational art." They reject basic military premises of preparing the battlefield and never allowing an enemy to strike first. However, these options offer the United States the most realistic method of protecting our vital satellite networks.

The following defensive measures need to be embraced and developed by U.S. military planners: treaties, system redundancy, smaller satellites with quick launch capability, Unmanned Aerial Vehicles (UAVs), leased assets, and physical defenses. No single option will provide complete security. Each of these measures will compliment the other. Additionally, these measures must not be developed in a U.S. vacuum; we need to combine efforts with allies to not only ensure U.S. space security, but worldwide satellite connectivity in both the national and commercial worlds.

The first defensive measure is treaty development. Currently, over 1800 satellites orbit the Earth. They represent an investment of more than $100 billion. U.S. News and World Report estimates that a further $250 billion will be spent in space by the end of 2003, and that another 1800 satellites will be in orbit by the end of this decade. These are not just U.S. assets, but also the world's investment. The door to a mutual agreement

among the world community not to attack another's space assets seems possible.[27] Interests will not only be served in the United States, but in other countries as well. With the military, other government agencies, the business world, and our allies working together as partners, we can leverage each other's investments to reduce the cost of space for everyone by removing the threat of attack.[28]

Treaties must address exactly what constitutes a space weapon, commitments not to employ them, mechanisms of verification/policing, and assurance of punitive response for violations. A treaty with the clause, "the attack on any space platform will be considered an act of war against all signatories of this treaty" would provide formal and instant coalition (or collective security) against any aggressor. Clearly, the United States has the opportunity and means to lead this diplomatic venture, as well as the resources to develop the methods and tools of verification.[29]

A second defensive measure is system redundancy. Designers should allocate satellite capability to a distributed network with a decentralized architecture rather than to a few high value satellites, thus reducing reliance on any single satellite. Fiber optic cables could further strengthen terrestrial up/downlink nodes by connecting numerous sites via multiple landline paths.[30] Proliferation results in a more robust system that gives an enemy too many targets to damage or destroy before there is a significant impact on the effectiveness of a system. An attacker has to expend more resources before there is any effective degradation to connectivity.[31]

A third defensive method is to shift the focus from large, expensive satellites to smaller units that are capable of quickly being launched into space or an idea that is even more radical, non-space based assets such as UAVs.

A new generation of small intelligence satellites, to be launched beginning in 2003, is expected to give U.S. analysts almost constant overhead images of specific trouble spots anywhere in the world. Unlike the older satellites, these will be launched within a 30-day notice, giving new flexibility to the force.[32] This capability relieves the pressure of losing a satellite. It sends a message to the world that the United States is in space to stay and that nothing can stop it from conducting operations in support of its national policy.[33]

Another similar option is to shift from satellite dependence to UAVs. UAV communications packages can equal the capability of Defense Satellite Communications Systems with dwell times ranging from 12 to 48 hours.[34] UAVs can also provide a tailored intelligence gathering capability with greater flexibility than traditional satellite gathering methods.

Taking this innovation one step farther, quick launch platforms could be mobile and deploy into the field. Deployment of either a small satellite or UAV would provide tailored information to the commander in the field. Launch authority is passed to the Joint Task Force (JTF) Commander who could launch satellites as required to either replace damaged assets or to gather specific data for field commanders.[35]

A fourth defensive option is to use leased vice national assets for information gathering and connectivity. A byproduct of the explosion of information is the migration of U.S. communications needs away from dedicated military satellites to commercial assets. Consequently, the United States is earnestly looking at commercial systems to handle more wideband high-data rate needs. Leasing of commercial sources occurred during Bosnia and Desert Storm conflicts. Currently, U.S. forces in Kosovo use leased

transponders on commercial satellites. Commercial systems have good reliability, high capacity, anonymity, and are cost-effective. As commercial assets grow and national assets are further constrained by limited funding, America will increase the number of leased satellite channels to support future communication needs.[36]

Granted leased assets would have some restrictions. Modification of orbit to observe specific events would be impossible. However, leased assets would offer the advantage of camouflage. As the United States is weary of destroying commercial satellites selling information to a rogue nation, other countries may hesitate to destroy an ally's satellite because it carries a U.S. channel.

A fifth option is physical defenses. Designed to reduce the effectiveness of enemy space systems targeted against friendly interests.[37] Physical defenses offer survivability techniques to make satellites hard to find and thus hard to hit.

Deception techniques hide the satellite. They include stealth or masking designs (reduced radar and infrared/optical signatures). Satellites can also be placed in deep-space storage orbits (even beyond geosynchronous) and maneuvered down as needed. When an enemy discovers and targets one of our satellites, we can make interception difficult or impossible by maneuvering the satellite or by ejecting decoys.[38]

Hide-and-seek defenses provide a preemptive measure of security. "Satellite cloaking," offers a unique passive method by minimizing reflection and maximizing absorption of energy with the goal of reducing the amount of energy reflected back to the sender. Cloaking will use active means to enable a satellite, as seen by enemy sensors, to blend into any environment. If a satellite is able to radiate emissions that make it appear to be non-threatening (or even appear to be friendly); it may be able to fool an enemy.[39]

Use of decoys will also serve to confuse the enemy. By saturating the battle space with large numbers of small, cheap satellites (which to enemy sensors appear to be high-value satellites), the problem of finding and destroying the truly critical satellite becomes more difficult.[40]

If an attack does occur, attack identification techniques, physical hardening, and prevention/avoidance techniques can improve the survivability of a satellite.

An onboard satellite sensor will identify that an attack on a satellite is in progress or has occurred. When integrated with space surveillance sensors, it will reduce the possibility of an enemy clandestine attack. It will provide the United States with sufficient information to exercise military and/or political options to prevent an attack, respond to the results of an attack, or to exercise responsive countermeasures.[41]

Physical hardening includes shielding from a variety of EM pulses as well as shielding from space debris.[42] Hardening is costly, allowing its use on only the most vital satellite assets. In addition, satellites carry fuel on board for station keeping operations which, given sufficient warning, can maneuver the satellite to avoid an attack.[43]

Use of secure command, control, and communications techniques (frequency hopping, low probability of intercept/low probability of detection, and signal encryption) reduce the effects caused by an attack. These avoidance techniques will also prevent jamming or spoofing of our transmissions.

Conclusion:

Protection of both U.S. and the world's satellite constellations is vital to military planning and general worldwide communications. The United States must take measures to ensure that satellite connectivity is not degraded or destroyed.

However, offensive weapons are not the answer. They will not deter aggression, provide information dominance in the battle space, or protect satellite assets. Offensive weapons will only serve to encourage others to accelerate ASAT research, alienate allies, encourage the weaponization of space, and waste limited funding.

The correct solution is defensive measures. Granted these are riskier, more costly, and in direct contradiction to military training, but these measures offer an ability to realistically protect assets without alienating allies or weaponizing space. Treaties, system redundancy, quick launch platforms, leased assets, and physical defenses will protect assets at a much reduce political and moral cost.

Due to the growing number of countries with the ability to launch a satellite, access to space-based information will only rise in the future. As more multinational corporations get into the satellite game, ownership of assets will become harder to identify. An ASAT weapon cannot deny satellite information to a rogue nation with the means to purchase the data from other sources. However, ASAT weapons can serve to push a rogue nation to deny all satellite information to all players by detonating a nuclear device in the atmosphere.[44]

Maybe even a greater reason to reject offensive weapons is due to the responsibility the United States has in molding the future of space. Long-term social, political, and economic responsibilities of the United States outweigh the prospect of a

short-term military advantage. The military's demand to weaponize space is based on the belief that it is the nature of humans to wage war, and space is the next logical battlefield. If we continue to assume that major global warfare fought through the medium of space is inevitable and prepare for it accordingly, we condemn ourselves to that future.[45]

Satellite information is here and available to all. Military planners need to accept this fact and plan accordingly. In the future, the isolation of nations will no longer be possible. U.S. military planners need to protect U.S. satellite connectivity via defensive measures and plan to fight an enemy with likely comparable satellite access.

This is not a self-defeatist attitude. This is a realistic approach to a growing expansion of information technology. Even if the United States develops ASAT weapons, it cannot use them. Short of destroying every non-U.S. satellite in space, America cannot isolate a nation by the use of offensive weapons. The United States would be better served by shifting limited funding to defensive initiatives of making satellite connectivity more resilient than pursuing a high-tech weapon, which offers no practical advantages.

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